

SARDINE FISHERY MANAGEMENT PLAN

(2012-2015)

Approved by the Fishery
Management Group foreseen in
Portaria n° 251/2010, of 4th March,
and submitted to MSC

March 2012

INTRODUCTION

The present status of the Iberian sardine stock is a matter of some concern, since it seems to show a decline of the stock biomass. The risk that such a decline might pose to the sustainability of the Iberian sardine fishery has led to an ICES recommendation for a drastic reduction in fishing effort and, therefore, of fishing mortality.

This situation also led to the suspension of the MSC certification of the sardine fishery, supported by the same data and conclusions.

The Portuguese sardine fishery possesses a long history of monitoring and control, with time series dating back to 1978. In later years, the Fishery Management Authority (presently *Direcção Geral de Recursos Naturais, Segurança e Serviços Marítimos*), has implemented restrictive catch limits, as a response to a perceived trend of decreasing stock biomass. The success of those measures was, however, not clear, with conflicting indicators not supporting a clear vision of decline reversal. This led to the above mentioned ICES advice.

It was therefore decided that a specific management plan should be in place in 2012, to ensure a fast and sustainable stock recovery. This document, the "*Sardine Fishery Management Plan – (2012-2015)*", defines the structure, terms and operational rules, the role to be played by each of the involved stakeholders, the objectives to be pursued, the harvest rules to be used and, in general, the steps and timings to be taken within the scope of this recovery plan.

This management plan adopts a precautionary approach to the present situation. Even though the latest indicators seem to indicate both that stock recovery may be under way, and that fishing mortality was not a determining factor in the previously observed SSB decline, the plan and the included harvest rules are designed in line with the drastic reduction in fishing effort recommend by ICES.

The presented harvest rules are, consequently, very restrictive, and are to be maintained until the moment when a new stock status evaluation is available. This reevaluation is expected to occur in late July 2012, in time with the upcoming WGANSA 2012 meeting. The results of this reevaluation will dictate if the harvest rule parameters which are now implemented, and the drastic catch limits they impose, should or should not be revised.

The harvest rules contained in this document represent a very considerable cooperative effort of the Portuguese sardine producers, operators and management authorities to contribute to the recovery of the Iberian sardine stock. However, this level of restrictions has very strong and deep social and economic impacts, and will quickly compromise the viability of the sector. The stock reevaluation of July 2012, and the parameter revision that it may imply is, therefore, deemed crucial, since it may hopefully confirm the trend of recovery that the latest data seems to indicate.

Since the sardine stock involves the full Iberian area, the need for an effective coordination of corrective measures between Portugal and Spain is explicitly addressed in this Management Plan.

This document was prepared within the scope of the *Comissão de Acompanhamento da Sardinha* committee (created by Portaria nº 251/2010, May 4th 2010) and, as such, in close cooperation with the Portuguese Fishery Management Authority. It represents, therefore, a commonly shared and agreed view.

THE MANAGEMENT PLAN

This management plan was specifically designed to address the issue of how to promote the recovery of the sardine stock, and to establish the harvesting rules to be adopted in the period 2012-2015. It does not, therefore, attempt to describe in full detail the Sardine Fishery Management structure currently in place in Portugal, or try to present in full detail its overall strategy. However, some of that information will be discussed, since it is vital to the clear presentation of the contextual framework, the overall operating processes and the identified stakeholders, and to evaluate the expected level of efficacy to be expected at the implementation phase of this plan. Hopefully, this contextual information will help to define a full, coherent and clearly understandable picture of the current situation and chosen objectives, without adding too much clutter to the main issues: the established courses of action, and the results to be expected.

When defining the courses of action to be adopted, it was necessary to estimate their future impacts, namely predicting the recovery profile of the sardine stock as a result of those actions. Hence, even though the *leitmotiv* of this particular plan is the definition and choice of the actions to be taken immediately, the timeframe considered for impact evaluation was much longer, encompassing the full decade 2011-2021.

OBJECTIVES

The “*Sardine Fishery Management Plan – (2012-2015)*”, even though specifically designed to address the present situation of the sardine stock, was devised within the encompassing framework of the existing Fishery Management structure. As such, it naturally shares and adopts the guiding overall objectives defined (see Table 1):

Table 1 - Overall Fishery Management objectives (Main objective, and Support objectives)

Guarantee optimized, sustainable fisheries
- Ensure the sustainability of resources
- Minimize the ecosystem impact of fishery activities
- Operate at maximum sustainable yield
- Improve the economical viability and social conditions of the sector
- Ensure the proper levels of cooperative governance

Adding to the stated objectives of the overall Fisheries Management structure, two specific objectives have been defined for the present plan (Table 2):

Table 2 - Specific Objectives of the "Sardine Fishery Management Plan – (2012-2015)"

- Contribute to the avoidance of further decline of the Iberian sardine stock, by reducing the fishing effort;
- Recover, with high probability, levels of stock biomass above B_{trig} by 2015;

GUIDING PRINCIPLES

The "Sardine Fishery Management Plan – (2012-2015)" is based on a clearly defined set of guidelines and principles, which are an integral part of all steps of this management plan:

Guidelines	
Predictability	Definition of an explicit set of objectives and rules will allow for increased predictability of management decisions. This will ease the decision making process for all stakeholders.

<p><i>Stakeholder involvement</i></p>	<p>A cooperative approach to Management Plan design is the safest way to ensure the adequate information flows, the recognition of the existing subsets of interests, and, consequently, the use of all existing data in the design process. Additionally, one must consider that plans must be implemented, and that the success of an implementation strongly depends on the degree of perception, adherence and commitment of the involved actors.</p>
<p><i>Context consideration</i></p>	<p>The sardine fishery health status is not an independent variable, nor can it be controlled uniquely with fishing effort policies. In fact, it depends on many other environmental external factors (anthropogenic or not) All of them should be considered, both in terms of their impact on stocks, and as information sources for proper monitoring and control.</p>
<p><i>Precautionary approach</i></p>	<p><i>Resource preservation</i> and <i>sustainable exploration</i> are long term goals not to be compromised. As such, precautionary approaches are favoured in this plan. The balance between precaution and rationality (see the last guideline) must be carefully maintained at all times.</p>
<p><i>Rationality</i></p>	<p>All measures must obey strict criteria of rationality. They must be <i>proportional</i> to the cause; they must be <i>useful</i> (measures with low levels of utility typically tend to increase the overall problem). Also, there should be no inversion of the burden of proof. Corrections should not be imposed on systems that fail to demonstrate their health, but only on systems whose lack of health has been shown.</p>

Most, if not all, of the choices made within the scope of this plan can be directly traced to one or more of these guiding principles. The definition of simple and clear harvesting rules and limits addresses *predictability*; the cooperative manner in which the plan was drafted, and the degree of consensus achieved, is aligned with the principle of *stakeholder involvement*; the considered monitoring and control mechanism takes into account the presently existing *context* (namely the body of work being executed in the context of the Marine Strategy Framework Directive (2008/56/EC)); the severe, decisive and drastic measures that were adopted are the direct result of a strongly *precautionary* approach; finally, all decisions were taken after careful and *rational* consideration of the potential utility of the measures under consideration.

THE FISHERY MANAGEMENT GROUP

The Fishery Management Group (*Comissão de Acompanhamento da Sardinha* committee) was created by Portaria nº 251/2010, May 4th 2010. It is chaired by the Portuguese Fishery Management Authority (presently *Direcção Geral de Recursos Naturais, Segurança e Serviços Marítimos - DGRM*), and involves representatives from all the relevant stakeholders:

- Instituto Nacional de Recursos Biológicos, I. P. — IPIMAR; (scientific laboratory)
- Docapesca, Portos e Lotas, S. A.; (Port operator)
- ANOPCERCO, Associação Nacional das Organizações de Produtores da Pesca de Cerco; (Association of Purse Seine Producer Organizations)
- ANICP, Associação Nacional de Industriais de Conservas de Pescado. (Canning Industry Association)

This Management Group ensures the cooperative nature of the management decisions. Adequate information flows are maintained, the different particular interests are recognized and debated, and all available data is used in the decision process.

The fact that the professional associations are part of the decision process and, hence, committed to the decision, ensures a fluid and successful implementation phase.

The Fishery Management Group responsibilities carry on to the control phase of the process, guaranteeing the correct levels of monitoring and control of implementation levels, objective prosecution, and identifying the need for measure readjustment.

THE MANAGEMENT PROCESS

The adopted management process is a customized variant of the traditional OODA loop. It is constituted by four sequential phases: *Analyse*, *Decide*, *Act* and *Control* (see Figure 1).

The description of each one of these phases is redundant, since they are self-explanatory. There are, however, three comments that should be made.

- Firstly, it should be pointed out that the four identified phases, even though being time limited and sequential within the scope of the decision process, are supported by activities which are typically continuous in nature. To exemplify, let us consider the “Analyse” phase. Even though, in the decision process, it

constitutes a time limited phase, occurring between the evaluation of the situation, and the decision phase, it is supported by scientific activity and data collection tasks that are continuously undergoing. The same can be said of all the other phases of the decision process;

- Secondly, even though cooperative in nature (and, therefore, requiring the involvement of all group members), each one of these phases has a different “leading actor” (not necessarily a single one):

Phase	Main driver
Analyse	IPIMAR (but much of the data to support scientific work is coming from other players)
Decide	DGRM
Act	ANOPCERCO
Control	DGRM, Docapesca (rule enforcement and monitoring is also being done by the Navy).

- Thirdly, we note that the decision process has, as its core and main goal, the establishment of a set of adequate Harvest Rules. As such, in Figure 1, the harvest rules were explicitly presented as the core around which the decision process of the Fishery Management Group must revolve.

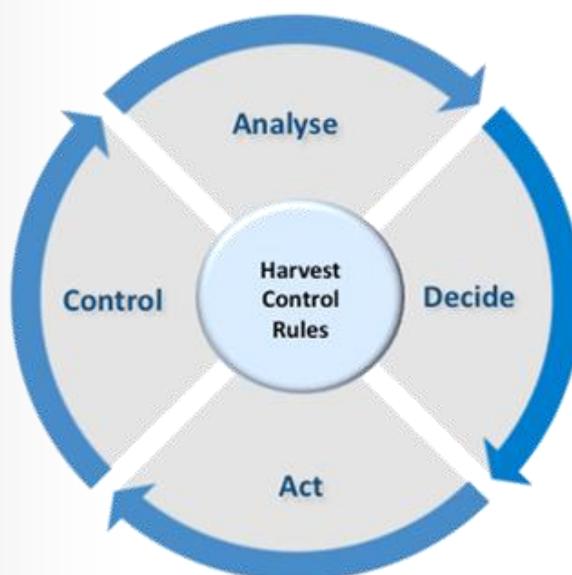


Figure 1 - Fishery Management Process

STOCK STATUS

The indicators reflecting the present status of the stock are not the ones that existed at the time of the ICES drastic recommendation, and the consequent suspension of the MSC certification. In this document, only the status of the indicators most relevant to the stock recovery plan will be addressed: fishing mortality, spawning stock biomass, and recruitment.

Fishing mortality

At the time of the ICES advice (July 2011), fishing mortality was estimated at $F_{2-5}=0.4284$ for 2010, a value considered to be "double the historical average". We note, however, that, the historical average being 0.2867 (ICES data), the ratio $0.4284/0.2867$ is 1.4942, not 2. Therefore, the value of F value estimated for 2010 was 49% above the historical average (47%, if we include 2010 in the averaging process) and not, by a huge margin, the 100% erroneously assumed in the Advice.

At the benchmark of 2012, the mortality time series was reevaluated, and the historical average for the fishing mortality (2-5) is now 0.2853 (0.2873 if 2010 is considered in the averaging process). Since the revised estimate for 2010 is 0.35, this means that fishing mortality in 2010 turned out to be 23% above the historical average, and thus, very distant from twice that value.

The fishing mortality value for 2011 is now known to have been 0.27, which means that F is already lower than the historical average (0.2873).

Additionally, both statistically (time series correlation) and pointwise (e.g. 1998), fishing mortality does not seem to be a determinant factor (and it most certainly is not the driving factor) in the observed biomass reduction.

Despite these facts, it is hoped that a decrease in fishing mortality may help the recovery of the stock biomass.

Spawning stock biomass

The estimated spawning stock biomass shows a consistent decrease in latter years. The estimated value for 2010 (upon which the ICES advice was passed) was of 172 kt, an absolute minimum for the historical time series of SSB. This value is 69% below the previous observed minimum value (250 kt, in the year 2000).

This decreased stock is the result of a sequence of diminished recruitments, and its cause is not clear, but seems to be ecosystem and environmentally driven.

It should be noted that it has not been possible to obtain full agreement from the different approaches to SSB estimation. The DEPM results of 2008, namely, do not corroborate the existence of the referred very considerable SSB decline. It is

hoped that additional acoustic surveys, and the final results of the 2011 DEPM campaign, may come to contribute to a convergence of estimates.

As a result of the changes to the model and parameter estimation methods adopted in the 2012 ICES benchmark assessment (the AMCI method was abandoned, and Methot's Stock Synthesis model was adopted), the SSB estimates have been revised.

From the resulting time series, the stock status, even though qualitatively similar to the previous evaluation, does present some noticeable differences, the most relevant of which is the fact that the SSB estimate for 2010 (280 kt) is now 94% of the second lowest value in the time series of SSB (297 kt, in 2000). Noting that the value of SSB in 2000 did apparently not hamper posterior good recruitments, this shows the present situation in a much more favorable light.

Recruitment

The recruitment time series does seem to be clearly dominating the SSB behavior. Recruitment is far from constant. In fact, it exhibits a strong periodic behavior (approximately 4 years of period). In Figure 2, we can see the power spectral density of the recruitment time-series; the peak at digital frequency 0.239 (corresponding to a period of 4.184 years) is clearly identifiable.

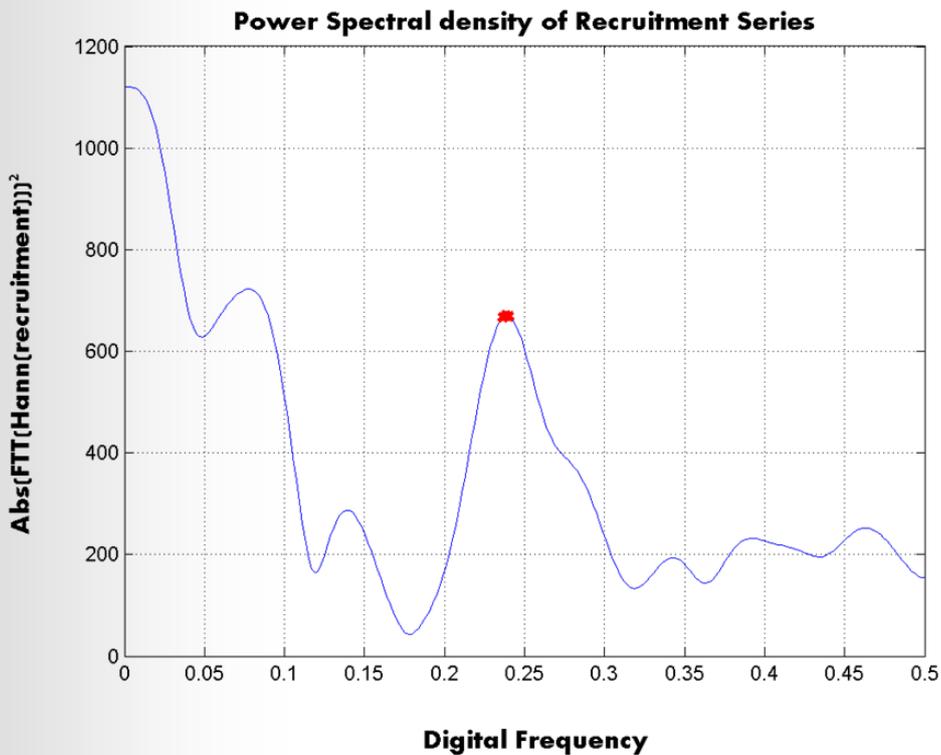


Figure 2 - Power Spectral density of the recruitment time-series

This type of behavior clearly implies that one should be very careful when applying models and fits which are based on a constancy of the recruitment time series, such as SSB/recruitment relations like Ricker or Beverton-Holt. Static variable relations are not amenable to use in dynamic systems, whose steady-state conditions are almost never reached.

Due to the new assumption of a non constant mortality-at-age, which implies higher natural mortality values at ages 0-2, the recruitment levels estimated in the 2012 benchmark assessment are considerably higher than the previous ones. However, the resulting time-series shows a similar historic behavior of diminishing recruitment (the periodicity notwithstanding).

It should be noted, however, that the recruitment levels based on DEPM alone do not support this general behavior, Again, it is hoped that additional surveys may contribute to obtain a coherent view, and that such a result may occur already in July 2012, at the next WGANSA meeting.

Despite all the above considerations, this management plan adopts, without any ambiguities, the following axioms:

- 1. There is a decreasing trend in the levels of recruitment;**
- 2. The levels of biomass are at the lowest point of the recorded time series;**
- 3. Reducing the fishing effort will positively contribute to the recovery of the stock.**

As already discussed, the WGANSA meeting of July 2012 is considered to be very important to clarify the uncertainties surrounding the exact status of the stock, since it will have additional data and results to consider.

ACTIONS

The accepted axioms relating to stock status did spur a very drastic set of actions both from the Portuguese Government (Despacho n.º 1520/2012, 1 February, of the Secretary of State of the Sea), and from the Fishery Management Group.

These measures were designed to coherently address the main issues identified above (low recruitments and decreasing SSB) and aim to:

- Recover, with high probability levels of stock biomass above B_{trig} by 2015;
- Alleviate the fishing pressure on the 2011 recruitment cohort, in particular;
- Adopt heavily precautionary and restrictive fishing activity levels until the July 2012 stock reevaluation;
- Reevaluate the fishery rule and its defining parameters in July 2012;
- Maintain a close and constant evaluation of the stock health indicators.

The option to specially address the reduction of the fishing pressure on the 2011 recruitment cohort is a natural option, since bad recruitments have been identified as the driving force for the apparent decline of the SSB.

THE HARVEST RULE

The adopted harvest rule is very restrictive. It was designed to allow for stock recovery above B_{trig} by 2015 with high probability, starting from the stock situation as perceived at the time when the ICES advice was passed. As has been previously discussed, this represents a biased, pessimistic view, which has since been revised. However, invoking the merits of adopting a precautionary approach, and the need for a quick increase of the stock, the group decided that drastic measures should immediately be taken to protect the juveniles, and that these strict measures should hold until July 2012, when a new stock reevaluation will be made.

The rule chosen for the period 2012-2015 can be seen in Figure 3.

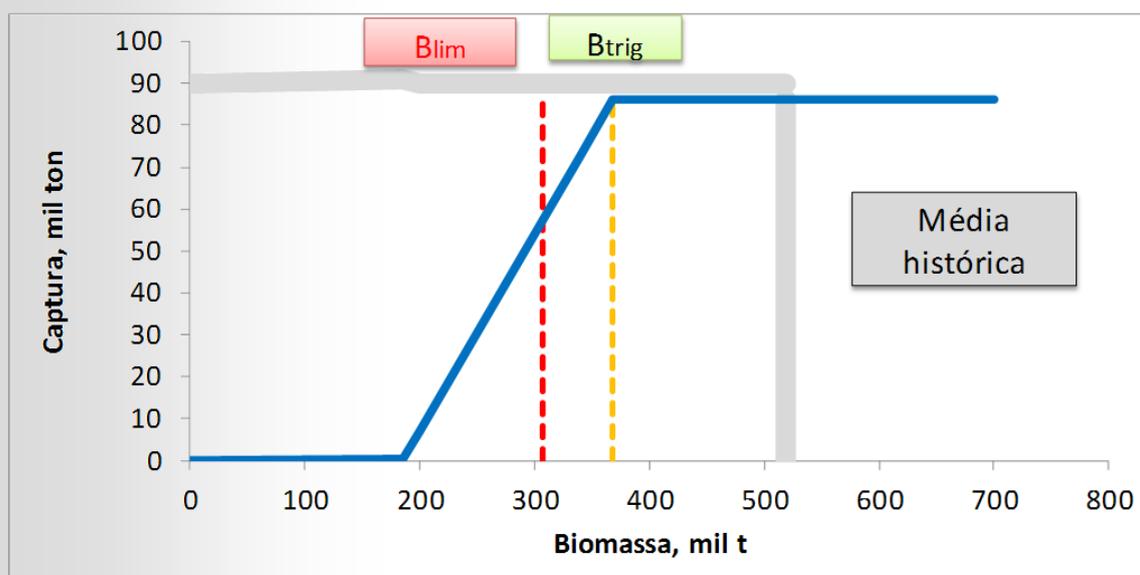


Figure 3 - Harvest Rule

Sardine Fishery Management Plan – (2012-2015)

The parameters in this rule have been defined as:

- $B_{lim} = 307$ kt (Biomass 1+)
- $B_{trig} = 368$ kt (Biomass 1+)
- Target catch = 87 kt
- Target true fishing mortality $F = 0.23$

The estimated recovery profile with these parameters can be seen in the following table:

Options	for	this	run:				
	TAC-rule	with	constraint on	TAC	variation	at	
	TAC	reduced	below	$B_{trigger}$	with	coefficient	alfa
Parameters:							
	Blow	Target	Ytt	B_{trig1}	B_{trig2}	Alfa1	Alfa2
	307	86	1	368.4	0	2	0
	Yearly	true	mean	values			
	Year	F	SSB	Catch	AbsIAV	Plim	
	2011	0.34	289	75	0	87	
	2012	0.18	268	41	65	90	
	2013	0.21	309	54	48	60	
	2014	0.21	341	62	39	41	
	2015	0.23	392	73	31	14	
	2016	0.23	443	82	18	2	
	2017	0.22	424	81	10	4	
	2018	0.22	412	79	11	6	
	2019	0.22	471	84	10	2	
	2020	0.22	487	85	4	0	
	2021	0.22	460	84	3	1	

As can be seen, this rule allows for >85% probability of being above B_{trig} by 2015.

The rule can be analytically expressed as follows:

IMPLEMENTED MEASURES

As stated, the Portuguese Government did take some drastic immediate actions, via Despacho n.º 1520/2012, 1 February, of the Secretary of State of the Sea. The most relevant ones are:

- A compulsory 45 days fishing ban was imposed in the period 01Jan/31APR 2012;

Every single fishing boat had to suspend sardine fisheries during a period of 45 days. Three different periods were defined, one for each production region (North, Center and South).

FEB15 - MAR30 – North
MAR01 – APR15 – Center
MAR15 – APR30 - South

The rule is being strictly enforced and executed. As of April 08th, fishing was resumed in the north production region, and is still banned at the center and south regions.

- A limit of 9000 tons for total landings was imposed for the period 01Jan/31APR 2012;

This limit is also being very strictly enforced and exemplarily respected. In fact, as of April 08th, the total number of catches is below half the 9000 tons established as a maximum for the period 01JAN-31APR. The landings' distribution by operator can be seen in Table 3:

Table 3 - Landings distribution by operator (01JAN-08APR)

Operator	Landings	Quota
APARA	157.1	397
APROPESCA	13.7	160
BARLA PESCAS	294.4	390
CENTRO LITORAL	301.4	1312
OLHÃO PESCAS	240.1	262
OPCENTRO	892.7	1139

CAPA	---	6
PROPEIXE OP	792.4	2760
SESIBAL	1053.2	1739
VIANAPESCA	174.1	565
NO_OP	180.5	270
TOTAL	3799.6	9000

- The 48h fishing ban on weekends is maintained.

Every weekend (between SAT-00h and MO-24h), a continuous ban period of 48h must be observed.

These measures are expected to have a very considerable impact on the young cohorts, and allow for a plentiful recruitment and, hence, for a quick biomass recovery.

Two final notes must be made, concerning the adopted measures.

Firstly, we should reinforce the fact that such heavily restrictive measures were taken in spite of the existing indications that the situation is better than had been initially estimated at the ICES advice. Hopefully, the July 2012 stock reevaluation will confirm this recovery, thus allowing the revision of the parameters of the harvest rule.

Lastly, the fact that the sardine stock is an Iberian stock must be properly stressed out. The success of any attempted corrective measures will be dependent on the corresponding action by the Spanish authorities and operators. The Portuguese Fishing Management Authority (DGRM) already initiated contacts with their Spanish counterpart, to foster and promote the needed levels of cooperation and alignment.

CONCLUSIONS

- Sardine Fishery Management is being done by a formally established Management Group. This group possesses a Management Strategy, with well defined processes, roles and objectives, and involves representatives from all the relevant stakeholders;

- A Harvest Rule is now in place. The relevant parameters have been defined in a very conservative manner, in order to allow for fast recovery of the stock. As defined, stock recovery should be finished by 2015, with high probability;
- The Portuguese Government, acting in coordination with the Management Group, has taken immediate and drastic actions to protect juveniles and, in general, to greatly decrease the fishing effort; these measures have been implemented, and are being rigorously executed;
- The Corrective Plan under way is very strong and demanding. The set of mitigation measures and rules contained in the plan was prepared to address what is now seen as a pessimistic view of the stock conditions. Even though that evaluation has now been revised, the Management Group chose to adopt a precautionary approach, and maintain drastic levels of response, until the moment when a stock reevaluation confirms that decline has been reversed, and that those stringent measures may, therefore, be attenuated. This will hopefully occur in July 2012.
- Even though both the compulsory 45 days fish ban and the drastic reduction in landings will have a huge impact on the income of fishermen, the producer's organization (ANOPCERCO) supported the decision, due to the recognized need to ensure the health of the sardine stock.
- There is a need to further involve the Spanish authorities, fishermen and associations, fostering bilateral cooperation and effort sharing. Being a common stock, one sided actions from the Portuguese side will not only have a lower degree of impact on the overall stock, but will also create a dissymmetry from where very considerable market distortions will occur, destroying all hopes of equity and balance in the distribution of equity and costs.